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THE PLACE AND CONTENT OF THE TOPIC "POSITION AND METRIC PROBLEMS" IN PERSPECTIVE

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Abstract
To improve the content of methodological recommendations on the practical application of positional, metric problems in perspective and develop methodological recommendations on their practical use in teaching engineering science.

Keywords: Positional problems, metric problems, geometry, spatial modeling, objects on the plane, distance calculation, Euclidean geometry, Pythagorean theorem.

Introduction

When depicting various objects in perspective, it is sometimes necessary to construct them taking into account the given conditions of their relative position. This is related to solving positional problems based on the simplest geometric methods of construction. We will consider positional problems in perspective using geometric constructions. This can solve problems, especially when creating perspective images. Their methods include similar triangles, auxiliary parallel lines, etc. The method of similar triangles is based on certain geometric positions.

If the center of similarity is given as (S), then similar triangles with the same name have their vertices on the same ray and their similar sides are parallel to each other. These rules are used to draw parallel lines in perspective with vanishing points. In perspective, the determination of the positions occupied by a particular object in space or the location of its elements relative to the object, and then its implementation in perspective, is called a "positional problem".

Positional problems include: determining the mutual positions of straight lines, constructing the intersection line of two planes, determining the point of intersection of a straight line with a plane, dividing the section of a straight line in a given ratio, drawing a straight line perpendicular to the plane, parallel to it. The mutual positions of two straight lines are determined in the following order according to the image given in the picture.

1. Mutually parallel straight lines. In perspective, the perspectives of the projections of such straight lines in H can meet at one point, that is, at points such as P, D1, D2, F1, F′1,... on the horizon line. Here a1 and b1 meets at F′1, and a and b meet at F1. Figure 1.

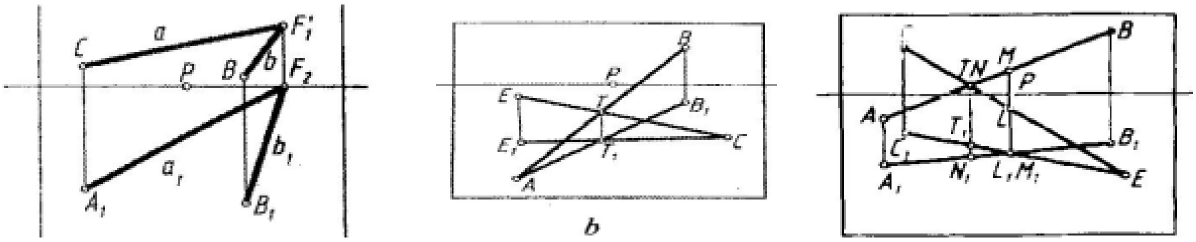
2. 

Figure 1. Here a 1 and b 1 meet at F' 1, and a and b meet at F 1.

2. Intersecting straight lines. In perspective, to determine the point of intersection of two straight lines in space, their image in H is first constructed. Then, if their intersection point lies on one vertical connecting line, they are considered to be intersecting in reality.

3. Non-intersecting (intersecting) straight lines. In perspective, such intersecting straight lines appear to be intersecting in reality.

To determine their mutual situations, their image in H is constructed. Then, if the intersection points in both images do not lie on one vertical line, they are considered to be intersecting lines. There are several ways to solve "Positional and Metric Problems" in Perspective.

1. Positional (conditional) problems.

1. Parallel straight lines

2. Intersecting straight lines.

3. Non-intersecting straight lines.

2. Perspective of two planes.

1. Intersection of a straight line with a plane.

2. Dividing a straight line segment in a given ratio.

3. Drawing a straight line perpendicular to a plane.

3. Metric (measurable) problems.

1. Determining the actual length of a straight line segment.

2. Determining the distance between parallel straight lines.

3. Determining the shortest distance between intersecting straight lines.

4. Determining the linear angle between two straight lines.

As an explanation, these can be explained with examples based on the "Two-plane perspective". Constructing the intersection line of two planes and the point of intersection of a straight line with a plane. These positional data are related to each other, since the constructions are based on the general positions of geometry.

To construct the intersection line of two planes, it is necessary to find two points belonging to it. To construct the intersection point of a straight line with a plane, an auxiliary vertical plane is drawn through it. Then the intersection line of the given with this plane is constructed. The point where the straight line intersects this line is the desired point. Constructing shadows falling down in perspective is a positional problem, which involves finding the intersection line of the light beam.

To construct a cast shadow, the projections of the light source and all characteristic points of the object must be placed on the surface on which the shadow falls, either in the picture or not far from it. In cases where the projections of the characteristic points of the object are not established in the drawing, they must be constructed. This will allow us to more accurately find the contour of the falling shadow.

Thus, we have seen the solution of positional problems by an example, in which it is not required to determine the size of the depicted objects. But how to construct in perspective if the dimensions of the objects are given and they are interconnected with the environment?

These constructions are based on the use of a perspective scale. Geometric methods are widely used in practice when constructing perspective images, in which metric conditions are not associated with exact dimensions. For example, dividing a segment into equal parts or increasing it several times.

The problems of finding the true size of an angle, distance, section or plane figure fall within the scope of metric problems. To depict real objects on a plane or any other surface, it is not enough to know only the methods of constructing their three-dimensional shapes and their relative spatial position.

It is also important to convey the metric data of objects, that is, their overall dimensions and the dimensions of individual parts, the distance between them and their relationships. For this, it is necessary to construct objects in perspective according to the given dimensions and to be able to determine the natural dimensions of objects from their images.

The real size of such sizes is determined in perspective, by superimposing them on a picture or by parallel projection to it. To depict real objects in a picture, it is not enough to know only the methods of constructing their three-dimensional shapes and their relative spatial position; it is also important to convey the metric data of objects, that is, their overall dimensions and the dimensions of individual parts, the distance between them and their relationship with the environment.

For this, it is necessary to construct objects in perspective according to the given dimensions (direct problem) and to be able to determine the natural dimensions of objects from their image in the picture (inverse problem).

Therefore, the representation of matrix data in the image of the relative location and size of objects with their elements is a metric issue in the long term. As is known, the sizes of objects in drawings are indicated by numerical scales of reduction (M1:100) or enlargement (M20:1).

Let's explain these symbols. A scale of M 1:100 indicates that the image in the drawing, for example, of a building is 100 times smaller than it actually is. A scale of M 20:1 indicates that the image of an object in the drawing is 20 times larger than its natural size.

Remember that in all cases, the drawings show their natural dimensions. However, the numerical scale used in the drawings cannot be used to construct perspective images! Why? Note that the objects surrounding us are depicted in the drawing, as a rule, smaller than their natural size. In addition, objects of the same size are depicted differently in perspective, depending on the distance and position in space. Consequently, the size of the objects depicted in the drawing is determined according to other rules or is set differently.

Perspective figures are used to construct according to the given sizes of objects in the drawing. This allows us to establish the relationship between the natural and perspective sizes of objects in the drawing. To do this, first set the size of the drawing perspective scales and their practical application with the natural length unit of the linear scale.

What is the size of the drawing? How is it used to construct perspective images? Imagine that several people draw the same still life, but taking into account the size of each paper, the size of the still life depicted, as well as the size of the painting, will be different for all artists.

Let's take another example. Imagine that several people draw still lifes and everyone has the same size of paper. However, one works on the head, the other on the inside. It is easy to understand that as the coverage of the space around a person bounded by the edges of a sheet of paper of the same size increases, the size of the depicted object decreases and, therefore, changes the scale of the painting. From the examples we have considered, it can be seen that the scale of the painting is a variable value.

Problems aimed at measuring some metric of a third geometric figure formed by the mutual arrangement of two geometric figures are called metric problems. For example, determining the true size of a third geometric figure - an angle formed by two intersecting straight lines. In solving metric problems, there are other geometric construction methods besides perspective scales.

Below we will get acquainted with the order of problems related to measurement. These are:

- determining the actual length of a straight line segment;
- determining the shortest distance between parallel straight lines;
- determining the shortest distance between non-intersecting straight lines;
- determining the shortest distance from a point to a plane;
- determining the angle between two straight lines;
- determining the linear angle between two planes;
- determining the linear angle between a straight line and a plane, etc.

Thus, we briefly considered the place and content of the topic “Positional and Metric Problems” in Perspective.

Conclusion:

Scientific views and sound information are provided on the history of the development of perspective and its practical significance, the current state of perspective teaching in educational settings, and the role and content of the topic "Positional and Metrical Issues" in perspective.

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